

## NEW RECORDS AND TAXA OF MARINE CHLOROPHYTA IN SOUTHERN AUSTRALIA

by H. B. S. WOMERSLEY\*

### Summary

Distribution and depth records are given for ten species of marine Chlorophyta. Two species of *Ulvaria* (*U. oxysperma* and *U. shepherdii* sp. nov.) are the first representatives of this genus known from southern Australia; records are given of three little known deep water species of *Caulerpa* (*C. alternans*, *C. ellistoniae* and *C. hedleyi*); the ranges of *Callipsygma wilsonii*, *Ayraultiella claviformis* and *Rhipiliopsis peltata* are extended considerably, and a second species of *Rhipiliopsis* (*R. robusta*) is described; and the subtropical species *Acetabularia calyculus* is recorded from St. Vincent Gulf, South Australia.

### Introduction

Since publication of a critical survey of the Chlorophyta of southern Australia (Womersley 1956), several species have become better known, especially from collections made by SCUBA divers. The more interesting of these records, together with two new species, are described below. Most of the species are from deeper water and rarely if ever are found in the drift.

A further deep water species, *Palmocladus stipitatus*, from deep water off Waldegrave Island, Eyre Peninsula, has been described separately (Womersley 1971).

### ULVALES

No species of monostromatic ulvacean algae has previously been recorded from southern Australia, although *Monostroma* and allied genera are present on most temperate and cold water coasts. Several species of *Monostroma* have been described from New Zealand by Chapman (1956).

Recognition of the genera of these monostromatic algae depends upon which species is accepted as lectotype of *Monostroma* Thuret. Following Kornmann (1964) and Bliding (1968), *M. bullosum* (Roth) Thuret is here accepted as the lectotype species, rather than *M. oxyspermum* (Kuetz.) Doty which Papenluss (1960, p. 315) and Gayral (1965, p. 627) regarded as lectotype. Kornmann and Bliding point out that *M. bullosum* agrees better with Thuret's type description of *Monostroma* than does *M. oxycoccum* (Kuetz.) Thuret (= *M. oxyspermum*).

*Ulvaria* Ruprecht is based on *U. obscura* (Kuetz.) Gayral, and differs from *Monostroma* in having an alternation of isomorphic

generations, a uniseriate germling which becomes tubular and opens to a monostromatic sheet, and distinct rhizoids at the base of the thallus. *Ulvaria* includes *U. oxysperma* (Kuetz.) Bliding when *Monostroma* is based on *M. bullosum*.

*Ulvaria oxysperma* (Kuetz.) Bliding 1968: 585, figs. 31-34.

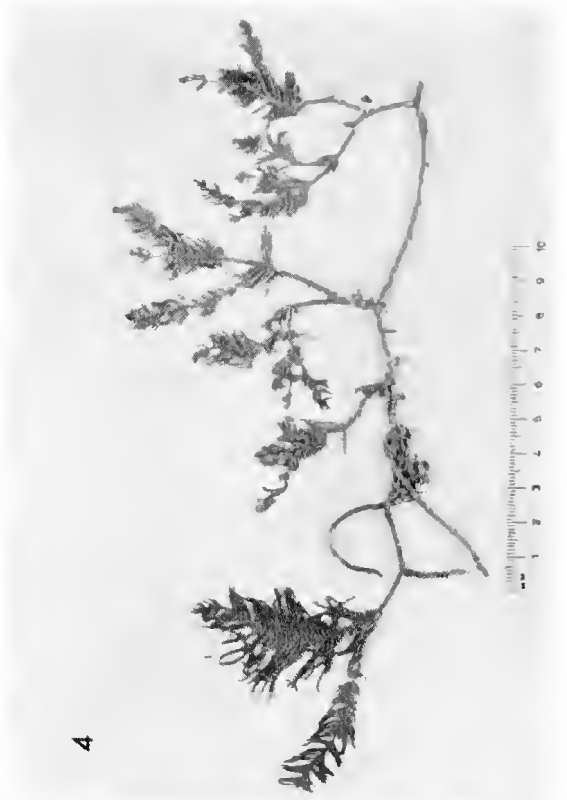
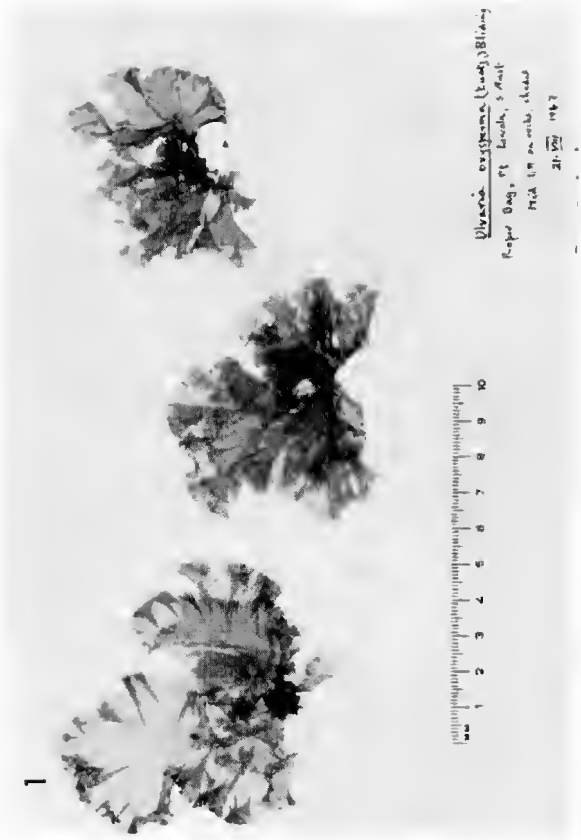
### FIG. 1

*U. oxysperma* was first recognised in South Australia in Proper Bay, Port Lincoln, during a field trip in August 1967 with Dr. C. den Hartog who was familiar with this species on European coasts. The South Australian plants agree well with Bliding's (1968, p. 585, figs. 31-34) description. They form light to medium green thalli (Fig. 1) up to 8 cm high and as much across, delicate but fairly firm, and with a smooth to convolute margin. The thallus is attached by rhizoids from the basal cells while the upper cells are irregularly polygonal to rounded in shape, 7-15  $\mu\text{m}$  across, with gelatinous walls of variable thickness, and arranged mostly irregularly though sometimes in groups or in linear rows. The thallus thickness is 10-15 (-20)  $\mu\text{m}$  and each cell contains 1(-2) small pyrenoids.

Most of these measurements are towards the lower end of the ranges given by Bliding.

*U. oxysperma* (often recorded as *Monostroma*) is a widespread species in the temperate northern Hemisphere and has also been recorded from subtropical regions (e.g. from Hawaii [Gilbert 1965, p. 483]). It is known from the following localities, but is probably widespread in suitable habitats during winter along the southern Australian coast. It is apparently a winter species and occurs at a

\* Dept. of Botany, University of Adelaide, Adelaide, S. Aust. 5000.



Figs. 1-4. Fig. 1.—*Ulvaria oxysperma*. Proper Bay, Port Lincoln, S. Aust. (ADU, A31812). Fig. 2.—*Ulvaria shepherdii*. Holotype sheet. Fig. 3.—

mid to lower eulittoral level in calm water bays and inlets.

*Localities*—Kellidie Bay, Coffin Bay, S. Aust., mid eulittoral (Womersley, 22.viii.1967; ADU, A31874); Proper Bay, Port Lincoln, S. Aust., mid eulittoral, partly shaded (Womersley, 20.viii.1967; ADU, A31812); Goolwa Barrage, S. Aust., mid eulittoral on stone bank, seaward side (Womersley, 13.iv.1970; ADU, A35820; Parsons, 5.viii.1969; ADU, A35746); Nelson Lagoon, Vic., on rocks (Beaglehole, 10.v.1959; ADU, A24674); Louisville, Tas., on *Heterozostera* (Olsen, 6.ix.1967; ADU, A31965); Port Arthur, Tas. (Cribb, 18.x.1951; ADU, A20434).

*Ulvaria shepherdii* sp. nov.

FIGS. 2, 5-7

Thallus (Fig. 2) to 12 cm high, deeply lacerate into numerous linear to narrowly cuneate, straight to slightly curved, segments with rounded to truncate ends, 2-15(-20) mm broad, arising from a small, semi-prostrate region attached on the lower side by numerous slender rhizoids (Figs. 6, 7) about 10  $\mu$ m diam. and about  $\frac{1}{2}$  mm long, often with lobed ends. Thallus monostromatic, 50-75  $\mu$ m thick below, decreasing to 30-40  $\mu$ m thick above, cells in section slightly to 1 $\frac{1}{2}$  times as high as broad.

Cells polygonal (Fig. 5), with rounded to narrowly angular ends, tending to form lengthwise rows, with walls 4-5  $\mu$ m thick; splits in thallus originating by separation of the walls between cells (Fig. 5). Cells 25-50 (-85)  $\mu$ m long by 10-25 (-35)  $\mu$ m broad (occasionally larger in some rows or patches), with the chloroplast filling most of the cell and containing usually 3-5 pyrenoids (Fig. 5).

*Diagnosis*—Thallus ad 12 cm altus, laceratus, segmentis linearibus vel anguste cuneatis 2-15 (-20) mm latis, per rhizoidea affixis. Monostromaticus inferne 50-75  $\mu$ m crassus, superne 30-40  $\mu$ m crassus. Cellulae polygonicae plerumque 25-50 (-85)  $\mu$ m longae et 10-25 (-35)  $\mu$ m latae, et chloroplastus cum 3-5 pyrenoidibus.

*Type Locality*—About 12 km (8 miles) south of Vivonne Bay, Kangaroo Island, S. Aust., from a craypot in 50-70 m depth (Latz, 24.xi.1968).

*Holotype*—ADU, A33006, holotype on left (Fig. 2).

*Distribution*—Only known from the type and from Pearson Is., S. Aust., on the rough water coast in 22-50 m depth (Shepherd, 7 to 12.i.1969; ADU, A33664, A33713, A33735, A33873, A34006, A34024, A34052, A34058, A34107).

*U. shepherdii* is named after Mr. Scoresby A. Shepherd whose subtidal ecological studies have contributed greatly to our knowledge of southern Australian marine algae.

*U. shepherdii* is placed in *Ulvaria* on the presence of distinct rhizoids developed from cells of a monostromatic thallus. The life history and development of the thallus is unknown. It appears most closely related to *Monostroma alittoralis* Tanaka & Nozawa ex Tanaka (1964, p. 75) from Japan. The latter is one of the few deep water species (from 60 m) of this group of algae and should probably also be referred to *Ulvaria*. It is similar in cell arrangement and rhizoids to *U. shepherdii* but differs markedly in form.

CAULERPALLES

*Caulerpa alternans* Womersley 1956: 364.

FIG. 3

This species was previously known only from the type locality (Port Phillip Heads, Vic.) and from "St. Vincent's Gulf, S. Aust., dredged in 20 fathoms" (ADU, A1562).

On 4 February 1969 it was collected by Mr. S. A. Shepherd near Troubridge Light (ADU, A33416) and Tapley Shoal (ADU, A33751) in the south west part of St. Vincent Gulf, in 17 and 13 m respectively, growing on a sandy bottom in an area subject to fairly strong tidal currents. The previous St. Vincent Gulf collection very likely comes from this area also, and the species appears to be confined to deeper water.

*C. alternans* is a slender species (Fig. 3) up to 8 cm high, with stolon and axes about  $\frac{1}{2}$  mm broad, the axes simple or with a few branches and bearing usually two rows of alternating, simple, slender linear ramuli up to 3 mm long and 200-300  $\mu$ m broad, with a pointed apex. Occasional axes bear ramuli in 3 rows or irregularly for part of their length.

*Caulerpa ellistonae* Womersley 1955: 387, fig. 2.

Previously known only from the type collection, *C. ellistonae* is now recorded from the following localities: Rottneest Is., W. Aust., 10

km south-west 62 m deep on rubble (Wilson, Feb. 1960; ADU, A24584); Pearson Is., S. Aust., 36 m deep on rough-water coast (*Shepherd*, 10.i.1969; ADU, A35153); Elliston, S. Aust., 7 m deep (*Shepherd*, 21.x.1970; ADU, A37537); 12 km S. of Vivonne Bay, Kangaroo Is., S. Aust., in 50-70 m from craypots (Latz, 24.xi.1968; ADU, A32992).

*C. ellistoniae* appears to be confined to deep water on rough water coasts, but with a wide distribution from Rottnest Island in Western Australia to Kangaroo Island in South Australia.

***Caulerpa hedleyi* W.v. Busse, Womersley 1956: 367.**

FIGS. 4, 8, 14

*C. hedleyi* was previously known only from the type specimen dredged in 15 m (8 fath.) off Kangaroo Island. It has now been collected from the following localities—Pearson Is., S. Aust., 22-30 m deep on sheltered coast (*Shepherd*, 8.i.1969; ADU, A33741 and 9.i.1969; ADU, A33998, A34054); St. Francis Is., Isles of St. Francis, S. Aust., 55 m deep (*Shepherd*, 9.i.1971; ADU, A38069); Egg Is., Isles of St. Francis, 32-38 m deep (*Shepherd*, 11.i.1971; ADU, A38084).

*C. hedleyi* appears to be restricted to deep water, off either rough water or partly sheltered coasts, but at depths where water movement is only slight and light intensity fairly low. *C. hedleyi*, *C. ellistoniae* and *C. alternans* are the only southern Australian species of *Caulerpa* known to be confined to deep water, though some other species penetrate from shallower into deeper water.

*C. hedleyi* is a distinctive species. The axes reach 10 cm in height from a long stolon (Fig. 4) and bear closely arranged distichous laterals (Fig. 14) which are densely covered with dichotomous ramuli with acute ends (Fig. 8). The lower axes are usually denuded of laterals but covered with ramuli.

***Avrainvillea clavatifurcata* Gepp & Gepp, Womersley 1956: 372.**

FIG. 10

This is the only species of the tropical-subtropical genus *Avrainvillea* known from southern Australia, and previously recorded only from the type locality, Corio Bay, Port Phillip, Victoria.

*A. clavatifurcata* is now known from Eucla, W. Aust., drift (Parsons, 5.xi.1968; ADU,

A33962); Waldegrave Is., Eyre Pen., S. Aust., 22 m deep (*Shepherd*, 23.x.1970; ADU, A37363) and Investigator Strait, S. Aust., 27 m deep, Lat. 35°13'S, Long. 137°31'E (Watson, 9.i.1971; ADU, A38441). It thus appears to be a deep water species, rarely found in the drift.

*A. clavatifurcata* reaches a height of 25 cm (Fig. 10), with long, terete stipes (to 13 cm), then expanding fairly evenly to a broadly flabellate lamina up to 10 cm long and 10 cm across at its flattened to convex apex. In old plants up to 10 stipes with blades may arise from an old matted holdfast (Fig. 10).

***Callipsygma wilsonii* J. Agardh, Womersley 1956: 372.**

FIG. 11

*Callipsygma* was known only from the type specimen from Port Phillip Heads, Vic. until recorded by Cribb (1958, p. 207) from Cape Barren Is., Tasmania (Olsen, 14.x.1950).

*C. wilsonii* is now known from numerous specimens in ADU, with records from Vivonne Bay, Kangaroo Island and from Port Elliot, S. Aust. to Sorrento, Vic. and King Is., Bass Strait (MELU—S. C. Ducker, *pers. comm.*). It appears to be a plant of deeper water on rough coasts, though it is common in 1-2 m depth in a heavily shaded cave at Nora Creina, south of Robe, S. Aust.

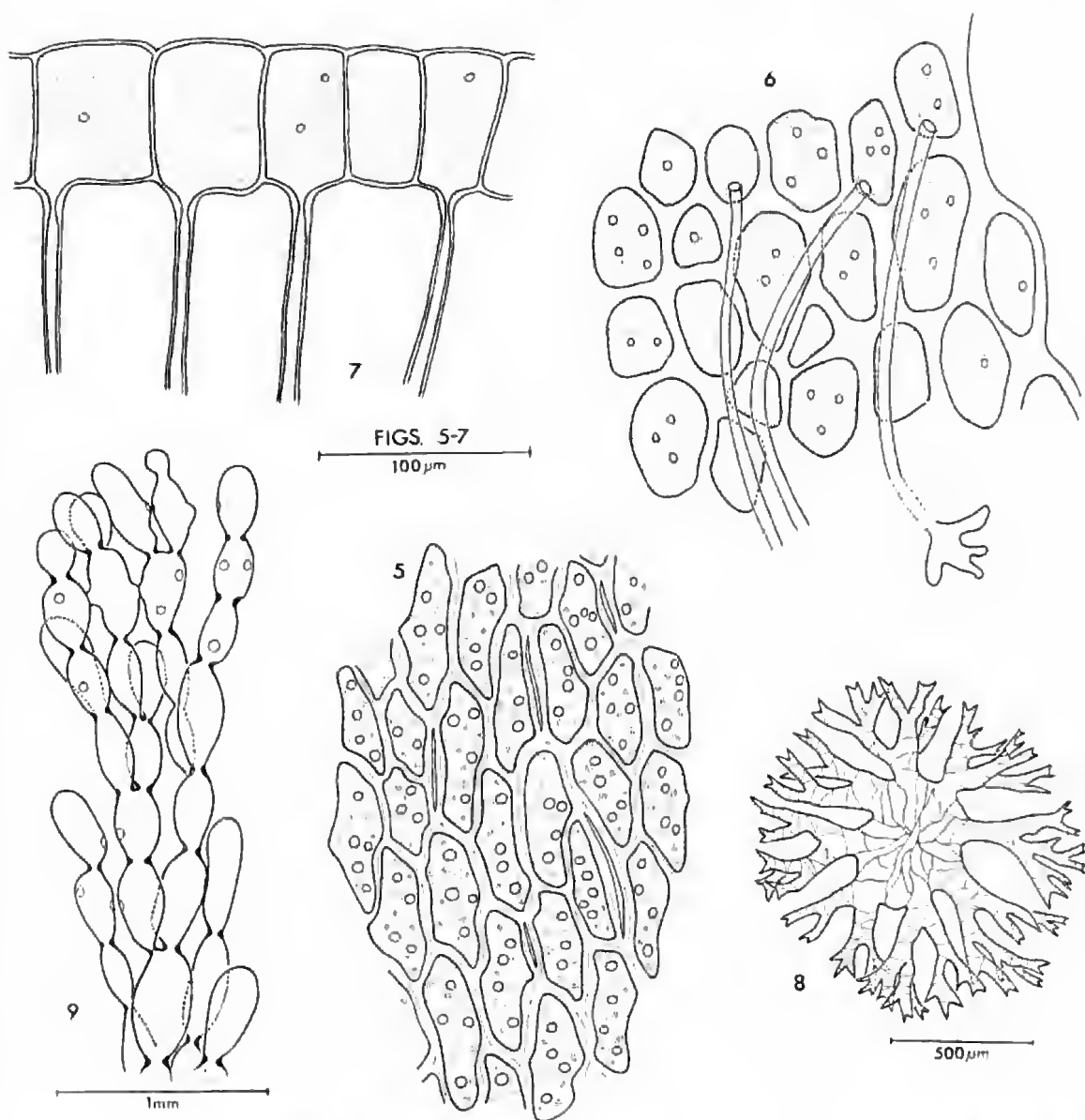
The thallus (Fig. 11) reaches 35 cm in height in old plants, with numerous branches, flabellate above and denuded below where the lower stipe may be 1-2 cm thick and the holdfast up to 3 cm across.

***Rhipiliopsis peltata* (J. Agardh) Gepp & Gepp, Womersley 1956: 376.**

FIG. 12

*R. peltata* was previously recorded from Port Phillip Heads, Vic. and Pennington Bay, Kangaroo Is., S. Aust. and is now known as far west as Waldegrave Is. (near Elliston), Eyre Pen., S. Aust., 22 m deep (*Shepherd*, 23.x.1970; ADU, A37368). It is often common in shaded pools and at just subtidal levels on rough water coasts, and is probably to be found in such habitats anywhere between Port Phillip Heads and Waldegrave Island or further west.

The thallus is distinctive, reaching 4 cm in height and 3(-4) cm across, the flat lamina being borne on a slender stipe up to 1 cm long (Fig. 12).



Figs. 5-7. *Ulvaria shepherdii*. Fig. 5.—Cells (with pyrenoids) in median part of thallus; splits developing between walls of some cells. Fig. 6.—Cells and rhizoids at base of thallus. Fig. 7.—Cross section of basal cells with rhizoids.

Fig. 8. *Caulerpa hedleyi*. Cross section of lateral with ramuli.

Fig. 9. *Rhipiliopsis robusta*. Filaments of lamina showing lateral attachments.

#### *Rhipiliopsis robusta* sp. nov.

FIGS. 9, 13

Thallus (Fig. 13) to 9 cm high, dark green, not calcified; holdfast to 1 cm across, stipe to 4 cm long and 2-3 mm diam., lamina to 4 cm high and 3½ cm across, undivided but often lacerate or slightly lobed, about 1 mm

and several filaments thick, with a faintly zoned appearance, spongy but moderately dense and firm; surface of lamina without cortical development but the ends of some filaments lying at the surface. Filaments (Fig. 9) of lamina robust, mostly 150-200 μm diam., dichotomously branched, markedly moniliform with ovoid segments 1½-2 times as long as broad (apical segments 2-3(—4)



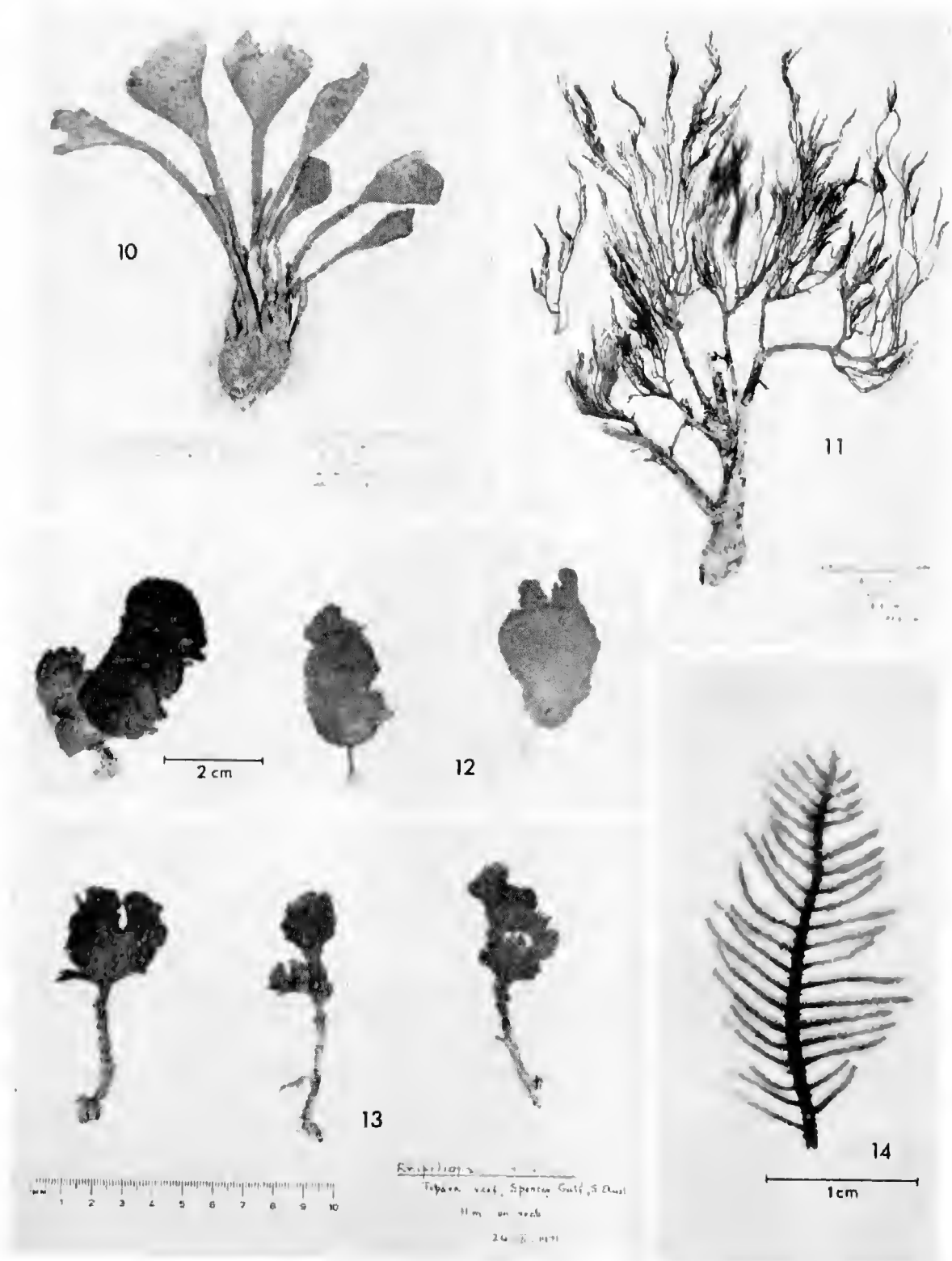


Fig. 10. *Avrainvillea clavatiramea*. Eucla, W. Aust. (ADU, A33962).

Fig. 11. *Callipsygma wilsonii*. Robe, S. Aust. drift (Bailey, 18.xi.1967; ADU, A32028).

Fig. 12. *Rhipiliopsis peltata*. Nora Creina (S. of Robe), S. Aust., in heavily shaded pool (Womersley, 17.i.1971; ADU A37817).

Fig. 13. *Rhipiliopsis robusta*. Holotype sheet.

Fig. 14. *Caulerpa hedleyi*. Axis with laterals and ramuli (A33741).

times as long as broad), with thickened wall plugs ingrowing from the periphery of the constrictions; filaments attached laterally by circular areas (Fig. 9) without projections from the filaments. Chloroplasts round to ovoid, 2-3  $\mu\text{m}$  long, without pyrenoids; amyloplasts ovoid, 3-5  $\mu\text{m}$  long.

*Diagnosis*—Thallus ad 9 cm altus, atro-viridis non calcareus; basali disco ad 1 cm lato, stipite ad 4 cm longo et 2-3 cm diam., lamina ad 4 cm alta et 3½ cm lata, indivisa vel lacerata circa 1 mm crassa. Filamentis robustis, 150-200  $\mu\text{m}$  diam., dichotomis, moniliformibus et segmentis 1½ vel duplo longioribus quam latis, ad constrictiones incrassatis; filamenta lateribus per poros circulares juncta. Chloroplasti rotundi vel ovoidei 2-3  $\mu\text{m}$  longi sine pyrenoidibus; amyloplasti ovoidei et 3-5  $\mu\text{m}$  longi.

*Type Locality*—Tipara Reef, Spencer Gulf, S. Aust., 11 m deep on rock (*Shepherd*, 24.ii.1971).

*Holotype sheet*—ADU, A38130, holotype on left (Fig. 13).

*Distribution*—Only known from the type locality and from Pearson Is., S. Aust.,

30 m deep on rough water coast (*Shepherd*, 10.i.1969; ADU, A34049).

*R. robusta* appears to prefer moderate water movement in fairly deep water. The two known localities are distant and other records are to be expected from SCUBA collections in similar habitats.

*Rhipiliopsis robusta* agrees well with the type species (*R. peltata*) in form and structure, and has similar lateral unions between the filaments by means of circular perforations. This latter character was used by Gepp & Gepp (1911, p. 46) to distinguish *Rhipiliopsis* from *Avrainvillea*. *R. robusta* differs from *R. peltata* in size and in its much broader and more strongly moniliform filaments, these being only 18-25  $\mu\text{m}$  broad in the latter. The only other species of *Rhipiliopsis* described appears to be *R. aegyptiaca* Nasr (1939, p. 53, figs. 3, 4) from the Red Sea, but this species is described as being monostromatic and is doubtfully a species of *Rhipiliopsis*.

#### DASYCLADALES

*Acetabularia calyculus* Quoy & Gaimard 1824: 621, pl. 90, figs. 6, 7. J. Agardh 1887: 171,

15



Fig. 15. *Acetabularia calyculus*. Living specimen from Tapley Shoal (Edithburgh), S. Aust. (corresponding to ADU, A33400).

Boergesen 1913: 75, figs. 61-65. De Toni 1889: 418, Harvey 1863: pl. 249. May 1938: 213. Nasr 1947: 40, figs. 10-11. Solms-Laubach 1895: 26, pl. 3, figs. 6-8, 10.

FIG. 15

*Acetabularia calyculus* is a widespread subtropical species, known previously in Australia from Fremantle northwards on the west coast and from about Newcastle northwards on the east coast. The type locality is Shark Bay, Western Australia. The original illustration of Quoy & Gaimard shows a fairly typical plant with a distinct cup of united rays, and as noted by Boergesen (1913, p. 77), Solms-Laubach's (1895, p. 26) reference of *A. calyculus* to a group with separate rays is not correct. After decalcification however, the rays readily separate.

*A. calyculus* is now known from the following records in South Australia: Tapley Shoal, off Edithburg, S. Aust., 13-15 m deep in strong current (*Shepherd*, 5.ii.1969; ADU, A33400—Fig. 15); Glenelg, S. Aust., in 20 m depth, 4½

km offshore (*Shepherd*, 15.ii.1969; ADU, A33450). In both cases, the alga was growing on dead shells on a sandy bottom, usually in current channels in *Posidonia* beds; current slight to strong. It appears to be confined to deeper water, and is recorded mainly from deeper water elsewhere in the world.

The occurrence of a further subtropical species in southern Australia is noteworthy, since a small group of such species is now known from the Gulf region of South Australia. Other species include *Hormophysa triquetra* (L.) Kuetzing and *Sargassum decurrens* (R.Br.) C. Agardh. The Gulf waters are warmer in summer than the rougher more southern waters, and it is possible that these may be "relict species" from a period of warmer conditions along southern Australia.

#### Acknowledgements

Gratitude is expressed to Mr. Scoresby Shepherd, whose SCUBA diving resulted in many of the records in this paper, and to the Australian Research Grants Committee for technical assistance.

#### References

- AGARDH, J. G. (1887).—Till algernes systematik. Nya bidrag. VIII. Siphonaceae. *Acta Univ. Lund.* **23**, 1-180, Plates 1-5.
- BLIDING, C. (1968).—A critical survey of European taxa in Ulvales, II. *Ulya*, *Ulyaria*, *Monostroma*, *Kornmannia*. *Bot. Notiser* **121**, 535-629.
- BOERGESEN, F. (1913).—The marine algae of the Danish West Indies. Vol. 1, Part 1. Chlorophyceae. *Dansk. Bot. Ark.* **1** (4), 1-160, map.
- CHAPMAN, V. J. (1956).—The marine algae of New Zealand. Part I. Myxophyceae and Chlorophyceae. *J. Linn. Soc., Bot.* **55** (360), 333-501 pls. 24-50.
- CRIBB, A. B. (1958).—A note on the structure of the green alga—*Callipsyigma wilsonis* J. Ag. *Pap. Dep. Bot. Univ. Qd* **3** (22), 207-208.
- DE TONI, J. B. (1889).—"Sylloge Algarum omnium hucusque Cognitarum". Vol. 1. Chlorophyceae (Padua).
- GAYRAL, P. (1965).—*Monostroma* Thuret, *Ulyaria* Rupr. emend. Gayral, *Ulvopsis* Gayral. (Chlorophyceae, Ulvotrichales): structure, reproduction, cycles, position systématique. *Revue gen. Bot.* **72**, 627-638, pls. 1-3.
- GEPP, A. & GEPP, E. S. (1911).—The Codiaceae of the Siboga Expedition, including a monograph of Flabellarieae and Udoteae. *Monogr. Siboga-Exped.* **62**, 1-150, p's. 1-22.
- GILBERT, W. J. (1965).—Contribution to the marine Chlorophyta of Hawaii II. Additional records. *Pacif. Sci.* **19**, 482-492.
- HARVEY, W. H. (1863).—"Phycologia Australica." Vol. 5, Plates 241-300, synop., pp. 1-73.
- KORNMANN, P. (1964).—Über *Monostroma hullosum* (Roth) Thuret und *M. oxyspermum* (Kuetz.) Doty. *Helgol. Wiss. Meeresunters.* **11**, 13-21.
- MAY, V. (1938).—A key to the marine algae of New South Wales. Part I. Chlorophyceae. *Proc. Linn. Soc. N.S.W.* **63**, 207-218.
- NASR, A. H. (1939).—Reports of the preliminary expedition for the exploration of the Red Sea in the R.R.S. Malahith. *Algae. Publ. Mar. Biol. Stn. Ghardaqa* **1**, 47-76, pl. 1.
- NASR, A. H. (1947).—Synopsis of the marine algae of the Egyptian Red Sea coast. *Bull. Fac. Sci. Fouad I Univ.* No. 26, 1-155, Plates 1-14.
- PAPENFUSS, G. F. (1960).—On the genera of the Ulvales and the status of the order. *J. Linn. Soc., Bot.* **56**, 303-318, pls. 1-6.
- QUOY, J. R. C. & GAIMARD, P. (1824).—Zoologie, in L. de Freycinet, "Voyage autour du Monde ... Exécuté sur les corvettes de S.M. L'Uranie et la Physicienne" (Paris).
- SOLMS-LAUBACH, H. GRAF ZU (1895).—Monograph of the Acetabularieae. *Trans. Linn. Soc. London* (Bot. ser. 2) **5**, 1-39, pls. 1-4.
- TANAKA, T. (1964).—Studies on some marine algae from Southern Japan. V. *Mem. Fac. Fish. Kagoshima Univ.* **12**, 75-91.
- WOMERSLEY, H. B. S. (1955).—New marine Chlorophyta from southern Australia. *Pacif. Sci.* **9**, 387-395.
- WOMERSLEY, H. B. S. (1956).—A critical survey of the marine algae of southern Australia. I. Chlorophyta. *Aust. J. mar. freshw. Res.* **7**, 343-383.
- WOMERSLEY, H. B. S. (1971).—*Palmocylindrus*, a new deep water genus of Chlorophyta. *Phycologia* **10** (in press).